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NONCONTACT CARD
[Hisesshoku IC kaado]

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Claims

1. A noncontact IC card having a center sheet on which a module hole is created,

a pair of thermoadhesive cover sheets of the same thickness and material that are joined to either side of said center sheet by means of hot-pressing, and

a module package in the shape of a coin, wherein electronic components such as an IC and an antenna coil are encapsulated between its flat surfaces using a resin, which is encapsulated inside the aforementioned module hole of the center sheet by the aforementioned cover sheets.

2. The noncontact IC card described under Claim 1, wherein the coversheet is 100-200 μm thick.

3. The IC card described under Claim 1, wherein a pair of thermoadhesive oversheets of the same thickness and material are thermally adhered to the respective surfaces of the cover sheets that are already thermally adhered to the center sheet.

Detailed explanation of the invention

[0001]

Technical field of the invention

The present invention pertains to a noncontact IC card used for communicating with a reader without any contact.

[0002]

Prior art

In recent years, IC cards equipped with a semiconductor element for recording/processing data have become more popular from the viewpoint of improved information processing and security. As such, so-called wireless noncontact IC cards, each containing an antenna coil for exchanging data by means of

electromagnetic waves and a semiconductor element for data processing so as to allow data to be read from/written to an external processor wirelessly, have been developed recently.

[0003]

In the case of a noncontact IC card of said kind, a noncontact module includes an antenna coil while the shape of the antenna varies depending on the communication frequency and function used. Furthermore, because a contact terminal is not required unlike with a conventional IC card, a manufacturing method that prevents exposure of module from the card surface from the aspect of a measure against electrostatic discharge and from the aspect of outer appearance is usually required.

[0004]

For example, as shown in Figure 4, a method in which module 100 created by combining an antenna coil and an IC module placed on the outer side into one body is sandwiched between resin sheets, or a method in which a concave part is created on a resin sheet by means of sedentary reeling, module 100 is installed in the concave part, and a resin sheet is further place on top of it so as to combine them, is available.

[0005]

When said methods, whereby the module is not exposed from the card surface, are used to manufacture a card, if the module is so thick that bumps become pronounced, the bumps are directly reflected on the card surface part where the module package is buried, resulting in a poor outer appearance. To eliminate said poor outer appearance, as shown in Figure 5, such external components as a semiconductor element, a coil, a capacitor, and a battery are installed on a substrate in the form of a module, [the module] is then encapsulated using an epoxy resin as needed so as to create coil-shaped

module package 200, and shaping (planarization) is applied. A method in which cover sheets 202 made of PVC, ABS or PET films are thermally adhered to said module package via adhesive films 201, or the cover sheets are thermally laminated directly, to form a card is available.

[0006]

Problems to be solved by the invention

However, when thermal lamination is used to join the cover sheets with the center sheet, the obtained card sometimes undergoes a warpage that is thought to be attributable to differences between the thermal conductivity and the thermal shrinkage factor of the card substrate and those of the module package. In particular, in the case of a 0.76 mm thick standard card, the thickness of the coversheets thermally adhered to the center sheet is 100-200 μm or so, resulting in a problem of significant warpage.

[0007]

The present invention was made in light of the aforementioned situation, and its objective is to present a noncontact IC card with which a warpage of the IC card, wherein a module package is buried in the substrate of the card, can be prevented.

[0008]

Means to solve the problems

In order to achieve the aforementioned goal, the present invention presents a noncontact IC card having a center sheet on which a module hole is created, a pair of thermoadhesive cover sheets of the same thickness and material that are joined to either side of said center sheet by means of hot-pressing, and a module package in the shape of a coin, wherein electronic components such as an IC and an

antenna coil are encapsulated between its flat surfaces using a resin, which is encapsulated inside the aforementioned module hole of the center sheet by the aforementioned cover sheets.

[0009]

For the layer configuration of the noncontact IC card of the present invention, the pair of cover sheets of the same thickness and material are thermally adhered to either surface of the center sheet while the center sheet is placed at the center. Then, the module package, which is created by burying the IC and other components therein and applying with planarization, is encapsulated inside the module hole created on the center sheet.

[0010]

From the viewpoint of the module package, said layer configuration is symmetrical in the thickness direction; and when forming the card substrate by thermally adhering the thermoadhesive cover sheets to the center sheet, heat is applied to the center sheet and the module package from both sides via the cover sheets. Even if the coversheets and the module package have different linear expansion coefficients, thermal shrinkage factors, and thermal conductivities, such differences surface on both surfaces of the module package, and because the degree of difference is the same on both surfaces of the module package, said differences offset each other, which eliminates possible warpage of the card substrate.

[0011]

In addition, for example, in the case of a 0.76 mm thick standard IC card with such a symmetrical layer configuration, 2 cover sheets are required, so each cover sheet is thin, that is, 100-200 μm or so. As such, the aforementioned differences in the linear expansion coefficient, the thermal shrinkage factor,

and the thermal conductivity in the module package can no longer be absorbed forcibly, and the possibility of the occurance of warpage increases. However, when the aforementioned symmetrical layer configuration pertaining to the present invention is adopted, the occurrence of warpage is less likely despite using thin cover sheets.

[0012]

Here, the term "the same," "the same thickness," or "the same material" as used in the Specification does not mean "the same" in a strict sense, but it is used loosely to include "substantially the same," which is sufficient for the prevention of warpage.

[0013]

Embodiment of the invention

An embodiment of the present invention will be explained in detail below. However, the present invention is not restricted to the embodiment described below. Figure 1 is a perspective view of an IC card pertaining to the present invention. In the case of said IC card 1, coin-shaped module package 10 containing an IC module is encapsulated in card-shaped card substrate 2 in order to realize read/write of data from/to an external device by means of a so-called wireless method. It is desirable to shift the position of module package 10 toward an edge part from the center part in the width direction of the card in order to avoid a bending stress that would otherwise be applied to the card.

[0014]

For the structure of said IC card, as shown in Figure 2(a), module hole 3a is created in 400-600 μm thick resin center sheet 3 by means of punching. Meanwhile, an antenna coil and an IC module are sealed using an epoxy resin or a UV-curable resin, and the top and the bottom surfaces are planarized

into the shape of a coin in order to create module package 10 with roughly the same shape and the thickness as those of module hole 3a of center sheet 3. A 400-600 μm thick center sheet 3 is placed on top of single 100-200 mm [sic; μm] thick thermoadhesive resin cover sheet 4a, module package 10 is placed in module hole 3a of center sheet 3, 100-200 mm [sic; μm] thick thermoadhesive cover sheet 4b of the same material and the thickness as those of cover sheet 4a placed below center sheet 3 is placed on top of center sheet 3, and center sheet 3 and cover sheets 4a and 4b are thermally adhered by means of hot-pressing under a pressure of 25 kg/cm^2 at 150°C for 15 min in order to encapsulate module package 10 inside card substrate 2 configured with center sheet 3 and cover sheets 4a and 4b adhered to either surface thereof. A standard 0.76 mm thick noncontact IC card can be created by combining said center sheet 3 and cover sheets 4a and 4b.

[0015]

The cross-sectional structure of IC card 1a created in said manner is shown in Figure 2(b). As shown in Figure 2(b), when cover sheets 4a and 4b of the same material and thickness are laminated on either surface of center sheet 3, the layer structure of card substrate 2 at module package 10 part becomes symmetrical in the thickness direction, and the aforementioned warpage or deformation attributable to the heat used during thermal adhesion is less likely to occur.

[0016]

An example asymmetrical cross-sectional structure of a conventional IC card is shown in Figure 6. Said IC card 300 has a structure in which module package 310 is placed in concave part 301 of center sheet 303, in which concave part 301 for burying module package 310 is created by means of sedentary reeling; and cover sheets or oversheets 304 are thermally adhered to either surface of center sheet 303. While the layer configuration of said IC card is symmetrical in the thickness direction at the part where

module package 310 is absent, the card substrate is not symmetrical with respect to module package 310 at the part that includes module package 310, so warpage occurs at the part indicated by the arrow due to the pressure and heat applied during thermal adhesion.

[0017]

There is no restriction regarding the resins used for center sheet 3 and cover sheets 4 pertaining to the present invention as long as they are thermoadhesive. For example, a polyvinyl chloride resin, polyethylene, polypropylene, polystyrene, an ABS resin, an acrylic system resin, a polyester resin, a polyamide resin, and a polyimide resin may be mentioned to this end.

[0018]

In addition, because the present embodiment adopts a method in which module hole 3a is created on center sheet 3 by means of punching, it is advantageous in terms of cost as compared to the sedentary reeling method whose cost tends to increase due to press-related damage attributable to misalignment of the module and the sedentary reeling cost.

[0019]

In addition, the IC card shown in Figure 1 can be configured using the components shown in Figure 3. As shown in Figure 3(a), to manufacture said IC card 1b, module hole 3a is created in 400-600 μm thick resin center sheet 3 by means of punching. Meanwhile, an antenna coil and an IC module are sealed using an epoxy resin or a UV-curable resin, and the top and the bottom surfaces are planarized into the shape of a coin in order to create module package 10 with roughly the same shape and thickness as those of module hole 3a of center sheet 3. For example, cover sheet 4a made of a 100-200 mm [sic; μm] thick thermoadhesive resin with a printed surface is placed on top of transparent 50 μm thick thermoadhesive

oversheet 5a, module package 10 is placed inside module hole 3a of the center sheet, and cover sheet 4b of the same material and thickness as those of aforementioned cover sheet 4a and transparent oversheet 5b of the same material and the thickness as those of aforementioned oversheet 5a are further placed on top. Center sheet 3, cover sheets 4a and 4b, and oversheets 5a and 5b are thermally adhered while said layers are layered together by means of hot-pressing under the condition of a pressure of 25 kg/cm^2 at 150°C for 15 min in order to encapsulate module package 10 inside card substrate 2b that is configured with center sheet 3, cover sheets 4a and 4b adhered to its surfaces, and oversheets 5a and 5b. A standard 0.76 mm thick noncontact IC card can be created by combining said center sheet, the cover sheets, and the oversheets.

[0020]

The same materials used for cover sheet 4 may be exemplified as materials to be used for oversheets 5a and 5b. The cross-sectional view of IC card 1b created din said manner is shown in Figure 3(b). As shown in Figure 3(b), when cover sheets 4a and 4b and oversheets 5a and 5b of the same material and thickness are laminated on either surface of center sheet 3, the layer structure becomes symmetrical in the thickness direction with respect to the center of module package 10, and warpage or deformation attributable to the heat used during the thermal adhesion is less likely to occur.

[0021]

Although card substrate 2 is configured with 3 or 5 layers in the aforementioned embodiments, a structure involving a larger number of layers may also be adopted without any problem as long as the layer structure in the thickness direction is symmetrical. The present invention is not restricted to the aforementioned embodiments. For example although the module package is formed into the shape of a

disk-like coin in the aforementioned embodiments, a square flat plate-like shape or any other shape may be used as long as both surfaces can be planarized.

[0022]

Effect of the invention

The noncontact IC card of the present invention has a lamination structure created by means of thermal adhesion, wherein the structure is less likely to be subject to warpage during thermal adhesion.

Brief description of the figures

Figure 1 is a perspective view showing an embodiment of the noncontact IC card of the present invention.

Figure 2 shows the embodiment of the noncontact IC card of the present invention, wherein (a) is a cross-sectional view of the components to be assembled, and (b) is a cross-sectional view after assembly.

Figure 3 shows another embodiment of the noncontact IC card of the present invention, wherein (a) is a cross-sectional view of the components to be assembled, and (b) is a cross-sectional view after assembly.

Figure 4 is a perspective view showing the manufacturing steps of a conventional noncontact IC card.

Figure 5 is a perspective view showing another example of the manufacturing steps of a conventional noncontact IC card.

Figure 6 is a cross-sectional view showing the structure of a conventional noncontact IC card.

Explanation of symbols

1 … noncontact IC card; 2 … card substrate; 3 … center sheet; 3a … module hole; 4a, 4b … cover sheet; 5a, 5b … oversheet; and 10 … module package.

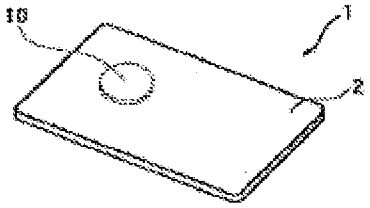

Figure 1

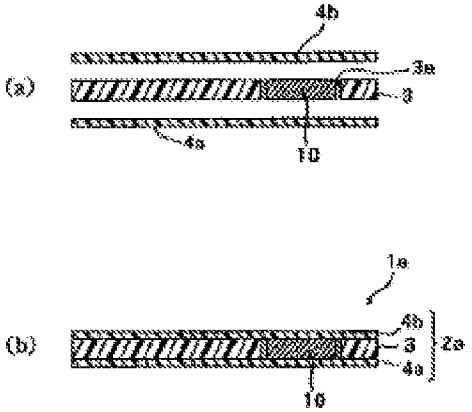

Figure 2

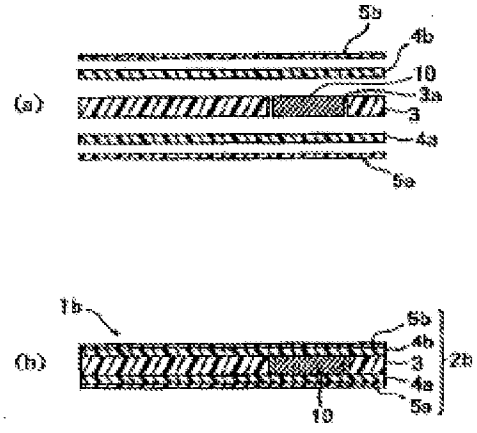

Figure 3

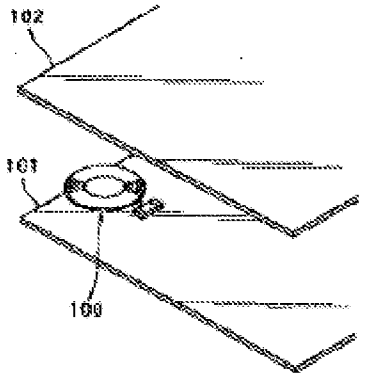

Figure 4

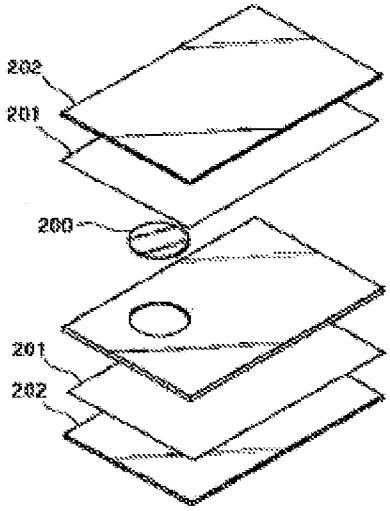

Figure 5

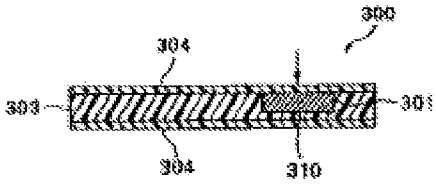

Figure 6